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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/786,140	02/28/2001	Eric Matthys	P368b	6642

63735 7590 09/03/2008

ERIC F. MATTHYS
1263 SAN ANTONIO CREEK ROAD
SANTA BARBARA, CA 93111

EXAMINER	
PATEL, NIHIR B	
ART UNIT	**PAPER NUMBER**
3772	
MAIL DATE	**DELIVERY MODE**
09/03/2008	PAPER

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Ex parte ERIC MATTHYS and KAZIMIR GASLIEVIC

Appeal 2008-2422
Application 09/786,140
Technology Center 3700

Decided: September 3, 2008

Before ERIC GRIMES, LORA M. GREEN, and FRANCISCO C. PRATS, *Administrative Patent Judges*.

GRIMES, *Administrative Patent Judge.*

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134 involving claims to devices and methods for improving heat transfer in a heat exchanger. The Examiner has rejected the claims as anticipated by and obvious in view of the prior art. We have jurisdiction under 35 U.S.C. § 6(b). We affirm in part.

BACKGROUND

"Drag-reducing additives can decrease friction in pipes with all else being equal. This reduced pipe wall friction does result in a decrease in the pumping power necessary to circulate a fluid in a piping system." (Spec. 1.) "Drag-reducing surfactant solutions reduce friction losses in turbulent pipe flow. However, when the turbulent exchange of momentum is reduced, so is the turbulent exchange of heat. As a result, the heat transfer in the pipes in [a] heat exchanger . . . is reduced too, impairing or prohibiting the use of drag-reducing in systems that involve most types of heat exchangers" (*id.* at 13).

The Specification discloses using a "degrading device" to break up the micellar structures in the surfactant solution, before the fluid enters a heat exchanger, to eliminate the drag-reducing and heat transfer-reducing properties of the surfactant solution in the heat exchanger (Spec. 4). The Specification discloses that a degrading device can be a grid or mesh screen disposed across the pipe, a plate with apertures, a grating, or "various other devices including wire loops, wall roughnesses, helices, and any other structure capable of creating fluid stress" (*id.* at 11-12).

DISCUSSION

1. CLAIMS

Claims 1-27 are on appeal. Claim 18 is representative and reads as follows:

18. A method of heat transfer recovery in turbulent flow in a heat exchanger by means of a drag reducing surfactant fluid characterized by degradation and recovery of drag reducing fluid properties comprising:

conditioning said drag reducing fluid properties of said drag reducing surfactant fluid;

providing a degrading device which degrades the fluid with minimum pressure drop;

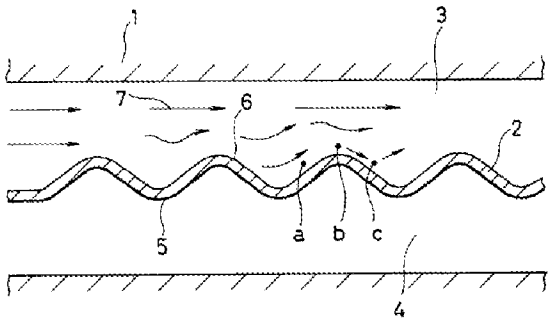
creating an initial temporary degradation of a circulating fluid in a flow of said fluid in said heat exchanger; and

after said fluid is initially degraded, creating additional disturbances in said flow to prevent recovery of the fluid.

2. ANTICIPATION

Claims 1-10, 14, 17, 18, and 23-27 stand rejected under 35 U.S.C. § 102(e) as anticipated by Kawaguchi.[1] Except for claims 6-8 (which are addressed below), the claims stand or fall together (Appeal Br. 5). We will focus on claim 18. The Examiner finds that Kawaguchi discloses a method that meets all the limitations of claim 18 (Office action mailed Feb. 6, 2003, at 6 (citing Kawaguchi, Figure 1 and columns 2-3).

We agree with the Examiner's finding. Kawaguchi discloses a heat exchanger using drag-reducing (DR) fluid, in which the heat exchanger includes "appropriately shaped irregularities" so that "the heat transfer of the heat exchanger can be increased while taking advantage of the drag reducing effect of the DR fluid" (Kawaguchi, col. 1, ll. 55-61). The DR fluid can contain a surfactant (*id.* at col. 3, ll. 2-5). Kawaguchi's Figure 1 is reproduced below:



[1] Kawaguchi et al., U.S. Patent 6,112,806, issued Sept. 5, 2000.

The figure is said to show one embodiment of the disclosed heat exchanger (*id.* at col. 2, ll. 60-65). Heat transfer plate 2 separates two fluid passages 3 and 4 (*id.* at col. 2, ll. 65-67). In Kawaguchi's system, heat is transferred from the fluid in passage 4 to the DR fluid in passage 3 (*id.* at col. 4, ll. 18-24).

Kawaguchi states that "the heat transfer plate **2** is formed with irregularities, [so] the velocity of the DR fluid is accelerated near protruding portions of the heat transfer surface 6, such as at point a in FIG. **1**" (*id.* at col. 4, ll. 4-7). Kawaguchi states that this localized acceleration results in good heat transfer; "[m]oreover, loss of the large scale structures in the solvent causes active motion. This turbulent eddy motion . . . produce[s] a further rise in the amount of heat exchange" (*id.* at col. 4, ll. 7-13).

We agree with the Examiner that Kawaguchi meets the limitations of claim 18. Kawaguchi's method includes:

- conditioning the drag reducing fluid properties of a drag reducing surfactant fluid (i.e., adding surfactant to a heat transfer fluid; Kawaguchi, col. 3, ll. 1-5);
- "providing a degrading device which degrades the fluid with minimum pressure drop" (i.e., providing the heat exchanger with irregularities that cause the loss of large scale structures; Kawaguchi, col. 4, ll. 4-13);
- "creating an initial temporary degradation of a circulating fluid in a flow of said fluid in said heat exchanger" (i.e., the loss of large scale structure resulting from interaction with a first irregularity in Kawaguchi's heat exchanger; Kawaguchi, Fig. 1); and

• "after said fluid is initially degraded, creating additional disturbances in said flow to prevent recovery of the fluid" (i.e., the prevention of large scale structure reforming because of interaction with subsequent irregularities in Kawaguchi's heat exchanger; Kawaguchi, Fig. 1).

Kawaguchi therefore anticipates claim 18.

Appellants argue that Kawaguchi does not mention micellar degradation by shear stress (Appeal Br. 5) and does not mention or imply breaking micelles by the irregularities in its heat exchanger (*id.* at 6).

We disagree. Kawaguchi states that the localized acceleration of the DR fluid in the vicinity of the plate irregularities causes "loss of the large scale structures in the solvent" (Kawaguchi, col. 4, ll. 8-9). In our view, the loss of large scale structures in a surfactant solution is most reasonably read to mean breaking of micelles. As Appellants have noted "any increased mixing necessarily increases the shear stress imposed on the fluid" (Appeal Br. 6). The loss of large scale structure in Kawaguchi's system therefore results at least partially from the increase in shear stress.

Appellants also argue that "[o]ne can increase mixing of a drag-reducing solution by any device, like Ka[w]aguchi's plate with irregularities, but heat transfer will not be recovered to the level of heat transfer which would be achieved if water were used instead of a drag reducing solution, unless the micelles are temporarily destroyed" (Appeal Br. 6).

This argument does not persuade us that the Examiner's rejection is improper. Claim 18 does not require any particular degree of micelle destruction or any particular level of heat transfer recovery. Since the claim

does not require these elements, the prior art need not teach them in order to anticipate.

Appellants also argue that Kawaguchi's heat transfer plate irregularities "will not degrade the fluid unless they are designed specifically to impose the exactly predetermined uniform shear stress (critical shear stress) which is needed to degrade a particular drag reducing solution" (Appeal Br. 6).

This argument is also unpersuasive. Appellants' argument implies that "degrading" a fluid requires substantially complete destruction of micelles. The Specification, however, does not define degrading to require imposing a critical shear stress or to require complete (temporary) destruction of micelles. The Specification states only that a "degrading device creates a stress field in or before the heat exchanger to break or disrupt the molecular or micellar structures in the surfactant solution by high local shear stresses so that heat transfer rate of the surfactant solution is increased" (Spec. 4).

"[D]uring examination proceedings, claims are given their broadest reasonable interpretation consistent with the specification." *In re Hyatt,* 211 F.3d 1367, 1372 (Fed. Cir. 2000). Under the broadest reasonable interpretation, claim 18 requires only some degradation (micelle destruction) in the heat exchanger; it does not require complete degradation or application of a critical shear stress.

We affirm the rejection of claim 18 as anticipated by Kawaguchi. Claims 1-5, 9, 10, 14, 17, and 23-27 fall with claim 18 because they were not argued separately. 37 C.F.R. § 1.192(c)(7).

Appellants provide separate arguments with respect to claims 6-8 (Appeal Br. 6-7). Appellants assert, correctly, that these claims are directed to a drag-reducing fluid having temperature-independent heat-transfer properties, such as that achieved by mixing two types of surfactants that exhibit opposite effects of temperature on their recovery kinetics (*id.* at 6). Appellants argue that "the idea of the mixing of two types of surfactants to balance the opposite effect of temperature on their kinetics of micelle formation" is not taught in the literature (*id.* at 7).

We will reverse the rejection as applied to claims 6-8. The Examiner finds that Kawaguchi teaches a temperature-independent heat transfer fluid (Office action mailed Feb. 6, 2003, at 4-5) but that finding is clearly wrong. Kawaguchi's Figure 2 shows that at high and low temperatures, the large scale structures in a DR fluid are destroyed and the fluid has no DR effect and good heat transfer, while at intermediate temperatures, large scale structure is present and the fluid has a DR effect and poor heat transfer. Kawaguchi's system is based on using the temperature-dependent properties of the DR fluid to allow good heat transfer while maintaining the DR effect of the fluid (see Kawaguchi, col. 3, l. 64 to col. 4, l. 32).

Kawaguchi does not disclose any DR fluid in which the DR effect and heat transfer properties are independent of temperature, and therefore does not support the Examiner's finding that it discloses a fluid meeting the limitations of instant claims 6-8. The rejection of those claims as anticipated by Kawaguchi is reversed.

3. OBVIOUSNESS

Claims 11-13, 15, 16, and 19-22 stand rejected under 35 U.S.C. § 103 as obvious in view of Kawaguchi and Brown.[2] Claim 11 is representative of the claims rejected as obvious, and is directed to a heat exchanger comprising first and second heat exchanging fluid paths, at least one of which comprises a dedicated degrading device disposed therein, and a heat exchanging fluid with a temporarily degradable drag reducing surfactant additive disposed in the heat exchanging fluid path, "wherein said dedicated degrading device imposes a flow disturbance or shear stress uniformly across a cross section of said corresponding heat exchanging fluid path in which said dedicated degrading device is disposed."

The Examiner relies on Kawaguchi for the disclosure discussed above. The Examiner finds that "Brown discloses a thin rod packing for heat exchangers that does provide a degrading device that imposes a flow disturbance or shear stress uniformly across a [ ]cross section of the corresponding heat exchanging fluid path in which the dedicated degrading device is disposed (see figure 1a)" (Office action mailed Feb. 6, 2003, at 8.) The Examiner concludes that it would have been obvious to modify Kawaguchi's system by providing it with Brown's device in order to provide better heat transfer (*id.*).

We agree with the Examiner that the cited references support a prima facie case of obviousness. Kawaguchi is discussed above. Brown teaches "a metal or ceramic thin rod packing positioned to impinge the fluid flowing within the heat transfer surface" of a heat exchanger (Brown, col. 2, ll. 11-

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[2] Brown, U.S. Patent 4,702,312, issued Oct. 27, 1987.

13). Brown teaches that the thin rod packing may take the "form of a screen heat exchange insert" (*id.* at col. 2, ll. 13-14) and that the insert "enhance[s] the heat exchange between the fluid and the heat exchange surface" (*id.* at col. 2, ll. 20-22).

We agree with the Examiner that it would have been obvious to a person of ordinary skill in the art to incorporate Brown's thin rod packing (e.g., in the form of a screen heat exchange insert) into Kawaguchi's heat exchange system because Brown teaches that its thin rod packing enhances heat exchange in a heat exchanger.

Appellants argue that, while Brown's device may impose a uniform shear stress to a drag-reducing fluid, "the intention of degrading the micelles is missing. . . . Following the Examiner's construction, Brown's thin rod packing would have a new use, not anticipated either by Brown or by Kawaguchi" (Appeal Br. 7).

This argument does not persuade us that the Examiner's rejection is in error. It is true that the references do not suggest combining the elements of the instantly claimed invention for the same reason Appellants combined them. However, the references provide a reason for those skilled in the art to combine their teachings, and that is all that is required for a prima facie case under 35 U.S.C. § 103. *See KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1741-42 (2007): "In determining whether the subject matter of a patent claim is obvious, neither the particular motivation nor the avowed purpose of the patentee controls. . . . [A]ny need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed."

We affirm the rejection of claim 11 as obvious in view of Kawaguchi and Brown. Claims 12, 13, 15, 16, and 19-22 fall with claim 11 because they were not argued separately. 37 C.F.R. § 1.192(c)(7).

SUMMARY

We affirm the rejection of claims 1-5, 9, 10, 14, 17, 18, and 23-27 as anticipated by Kawaguchi, and the rejection of claims 11-13, 15, 16, and 19-22 as obvious in view of Kawaguchi and Brown. However, we reverse the rejection of claims 6-8.

AFFIRMED-IN-PART

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ERIC F. MATTHYS
1263 SAN ANTONIO CREEK ROAD
SANTA BARBARA CA 93111